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Between the NEET and the tidy - Exploring 'middle' outcomes in Scottish school qualifications

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ABSTRACT

Despite changes in the education system the qualifications that are gained at school remain important for young people's pathways and trajectories. This paper is an element of a wider on-going programme of theoretically informed empirical analyses, which examine young people's educational outcomes. The empirical work is situated within an overarching theoretical sociological framework which focuses on the outcomes of 'ordinary' young people who are neither educationally unengaged, nor part of an educational elite. In this phase of the work we focus on outcomes in Scottish school-level qualifications.

This research is original in that it uses administrative data from the Scottish Qualifications Authority that is held as part of the Scottish Longitudinal Study. We begin by reconsidering challenging issues associated with measuring school-level qualifications. To address these challenges we undertake analyses of pupil's subject-area outcomes using a latent variable modelling approach. A novel aspect of the work is that we undertake a sensitivity analysis to compare a standard technique for latent group assignment (modal assignment) with a recently proposed alternative (proportional assignment).

The overall message is dispiriting because after half a century of comprehensive education in Scotland, school outcomes remain stratified both by gender and by a pupil's social background. The analyses uncovered four main latent educational groups. One group had very positive outcomes and pupils in this group were generally more socially advantaged. By contrast another group had very poor outcomes and pupils in this group were generally more socially disadvantaged. There were two 'middle' groups, which both had moderate overall school Standard Grade outcomes. These two 'middle' groups were similar in their overall outcomes, but at the subject area-level their outcomes were notably different. One group were more likely to gain a Credit pass in English, but were relatively less likely to gain Credit passes in Mathematics and Sciences. The other group were unlikely to gain Credit passes in English and Mathematics, but were more likely to gain Credit passes in Sciences. These pupils with 'middle' or 'moderate' outcomes in school Standard Grades are a sociologically important group that should not be overlooked.

The latent variable approach offers an informative set of typologies that are likely to be impactful because they can be used to better understand patterns of educational outcomes. These typologies are important because they can directly inform current debates on raising standards in Scottish schools.

KEYWORDS

Educational Outcomes; Scottish Standard Grades; Missing Middle; Sociology of Youth; Scottish Longitudinal Study; Latent Class Models.

EDITORIAL NOTE

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BETWEEN THE NEET AND THE TIDY – EXPLORING 'MIDDLE' OUTCOMES IN SCOTTISH SCHOOL QUALIFICATIONS

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1. INTRODUCTION

Transitions at the end of compulsory education have been a key theme in the sociology of youth, and have been the subject of numerous post-war studies (Clarke 1978). In the decades following the Second World War the vast majority of young people in Britain left education at the earliest opportunity (Furlong and Cartmel 2007). Pissarides (1981) clearly documents the upward trend in participation in post-compulsory education. Banks et al. (1992) note that there was always a minority of young people who remained in education for long periods before entering the labour market, but staying-on in education is now commonplace. Bolton (2012) reports that between 1980/1981 and 1993/1994 staying on rates for 16 year olds increased from 42% to 74%, and that at the end of 2011 an estimated 86% of 16 year olds in England were in full-time education. A comparable percentage of Scottish pupils stayed-on at school after the minimum school leaving age[1].

There have been manifest changes in the management and organisation of British schools, and this has resulted in changes in both the curriculum and qualifications. Despite the various changes to school qualifications their social significance is preserved (Noah and Eckstein 1992). Jones, Joyce, and Thomas (2003) clearly illustrate that overall workers with poor school-level qualifications generally have less favourable labour market outcomes. Babb (2005) similarly concludes that young people's experiences at school and their qualifications are strong determinants of their future success in both education and employment. Leckie and Goldstein (2009) remind us that for young people who choose to leave education at the minimum age, their school qualifications are often their only educational qualifications. School qualifications are also strongly related to participation in post-compulsory education (Payne 1995, Rice 1999, Payne 2000, 2001, 2003). Through the detailed examination of repeated contacts data, Murray (2011) reports that the negative effects of poor outcomes in school qualifications follow young people into early adulthood. The qualifications that are gained at school continue to be consequential, and are therefore worthy of sociological investigation.

[1] http://www.gov.scot/Publications/2011/12/06114834/28 accessed 29/02/16.

This paper is an element of a wider on-going programme of theoretically informed empirical analyses which examine young people's educational outcomes. In this phase of the work we focus on outcomes in Scottish school-level qualifications. This paper is original because it uses administrative data from the Scottish Qualifications Authority linked to individual and parental information for young people from the Census, both of these datasets are held as part of the Scottish Longitudinal Study. We begin by situating the work within a wider theoretical framework which focuses on the outcomes of 'ordinary' young people. We then reflect on the challenge of measuring and analysing school-level qualifications. In the main body of the paper we present a series of original empirical analyses of young people's outcomes in Scottish school-level qualifications.

2. THEORISING ORDINARY YOUNG PEOPLE

There is a long track record of British sociologists studying young people and educational outcomes (e.g. Douglas 1964, Hargreaves 1967, Douglas, Ross, and Simpson 1968, Lacey 1970, Wedge and Prosser 1973, Willis 1977, Corrigan 1979, Rutter et al. 1979). The orientation of many of these studies was the analysis of under-achievement. More recently theoretical and empirical attention has followed the political concerns regarding young people Not in Education, Employment or Training (NEET). As far as we can tell this concept, and the acronym, had its genesis in a report by the Social Exclusion Unit (1999), having previously been labelled as 'Status Zer0' (see Williamson 1997). The NEET have received a significant amount of research attention and notable examples include Bynner and Parsons (2002), Popham (2003), Furlong (2006), Yates and Payne (2006), and Robson (2011). Roberts (2011) argues that as well as studying those that are NEET there has also been a tendency for youth researchers to focus on 'tidy' pathways after school that are often favoured by Governments (e.g. through further and higher education). We suspect that the research orientation towards 'tidy' pathways is at least partially a consequence of wider structural changes in the post-compulsory education landscape that young people now navigate. In Britain the provision of further education expanded in the 1980s (Further Education Funding Council 1997, Smithers and Robinson 2000, Hyland and Merrill 2003). Since then a reasonable amount of analytical attention has focussed on studying the outcomes and experiences of post-16 learners (notable examples include Gray,

Jesson, and Tranmer 1993, Hughes, Taylor, and Tight 1996, Tight 1998, McVicar and Rice 2001). Much of this work has been located within the wider sub-area of lifelong learning (Field 2005).

During the early 1990s the UK moved away from a system of elite higher education to a system of mass higher education (Daniel 1993, Dearing 1997, Tight 2009). There are now a large number of universities and record numbers of young people enter higher education. One of the most striking features is that female participation rates have outstripped male rates (see Department for Business Innovation and Skills 2012). Researchers have been active in studying access to, and participation in, higher education (examples include Paterson 1997, Connor 2001, Archer, Hutchings, and Ross 2003, Forsyth and Furlong 2003, Gorard 2005, Reay, David, and Ball 2005, Iannelli, Smyth, and Klein 2015).

The perception that the sociology of youth has focused on either NEET young people or 'tidy' pathways has prompted an appeal to study the social lives and educational experiences of 'ordinary kids'[2], although similar appeals have previously been issued (see Brown 1987, Jenkins 1983, Pye 1988). The omission of the bulk of young people with unspectacular educational outcomes has led to the deployment of the term 'missing middle' (see Roberts 2012). An emerging theme within this current phase of youth research is that the experiences of 'ordinary kids' have largely been absent from contemporary accounts of education.

Roberts (2012) appeals to youth researchers to better document the experiences of ordinary young people through the analysis of large-scale datasets. Our wider on-going programme of theoretically informed empirical analyses of young people's educational outcomes using both social survey datasets and administrative education data answers this clarion call. This present work complements, and extends, the work presented in three recent papers.

Analysing data from the British Household Panel Survey, Connelly, Murray, and Gayle (2013) explored the middle ground between pupils that were educationally

[2] A special issue of Sociological Research Online 2013 18(1) was devoted to this topic.

successful and pupils that were unsuccessful. They identified a group of pupils with 'middle' levels of school GCSE outcomes. Drawing on the panel design of the BHPS (i.e. repeated contacts with the same young people) they examined activities in early adulthood. They compared this 'middle' group's education and economic activities with both their more and less educationally successful counterparts. The 'middle' group differed in their economic activities in early adulthood, and notably made the transition from education into employment earlier.

Following on from this research, Gayle, Murray, and Connelly (2014) performed a replication study using the Youth Cohort Study of England and Wales (YCS). The YCS is a specialist youth dataset and comprises a number of samples based on school-year cohorts. Through the analysis of pooled data they investigated school GCSE outcomes and concluded that educational inequality persisted throughout the 1990s and into the early 2000s. They reported that the overall pattern of school examinations had been one of improved performance, however GCSE attainment remained highly stratified. Young males had worse outcomes than young females, and there were also some marked differences in outcomes for pupils from the main minority ethnic groups. A prominent result was the impact of parental socioeconomic positions, and to a lesser extent other variables measuring the young person's home environment.

In a more recent paper, Playford and Gayle (2016) analysed subject-level school GCSE outcomes using a latent variable approach. This work was restricted to a single cohort of the YCS. They identified substantively interesting subject-level patterns of school-level GCSE outcomes that would be concealed in analyses of overall measures, or analyses of outcomes within individual GCSE subjects. The modelling process uncovered four distinctive latent educational groups. The first latent group was characterised by good GCSE outcomes, and another latent group was characterised by poor GCSE outcomes. There were two further latent groups with 'middle' or 'moderate' GCSE outcomes. These two latent groups had similar levels of overall (or agglomerate) outcomes, but one group had better outcomes in science GCSEs and the other had better outcomes in arts GCSEs.

In this paper we use contemporary Scottish data to further investigate the concept of 'middle' or 'moderate' outcomes in school qualifications. The overall theoretical aim of the paper is to make an empirically informed contribution to the current debate on the educational experiences and outcomes of 'ordinary' young people growing up in contemporary Britain.

3. SCOTTISH SCHOOL QUALIFICATIONS

The United Kingdom of Great Britain and Northern Ireland comprises four constituent territories (of which England is the largest). Each of the four territories has separate responsibilities for education. Raffe (2000) asserts that the education and training systems within the UK exhibit two striking features. First, while they differ in a few important respects they are similar in many others, and share recognisably 'British' features. Second, the two systems are politically and functionally interdependent, and they are shaped by common socioeconomic and political factors. The school education systems within the four territories are far more similar to each other than they are to the education systems in most other nation states. In the Scottish education system qualifications at the end of compulsory school are the first major branching point (or junction) in young people's educational journey. School qualifications in Scotland are important because they send pupils along different educational, and ultimately occupational, pathways. Therefore we consider that school Standard Grade outcomes are worthy of more detailed sociological examination.

Scotland moved to a system of comprehensive education in the mid-1960s (Murphy 2015). Between 1984 and 2013 the final years of compulsory schooling in Scotland led up to Standard Grade qualifications[3]. Standard Grades were similar to the General Certificates of Secondary Education (GCSEs) which are the standard qualifications in other parts of the UK. Standard Grades performed similar roles to GCSEs as the main predictor of educational activities post-age 16, and were also similarly valued in the labour market (Raffe et al. 1999).

[3] Standard Grades were the central school qualifications in Scotland for almost 30 years. They have now been replaced by the new 'National' Qualifications Framework (SCQF 2015).

4. MEASURING STANDARD GRADE OUTCOMES

Measuring education and educational qualifications is a complex endeavour as there is no single agreed-upon way to categorize educational qualifications (see Prandy, Unt, and Lambert 2004, Schneider 2010, Schneider 2011, Gayle, Connelly, and Lambert 2015a). The structure and organisation of British school credentials means that qualifications are vexing to measure. In essence this is because the curriculum in the final years of compulsory schooling incorporates a degree of flexibility and pupil choice, and each academic subject (e.g. English, Maths, Biology, French and so on…) is awarded an individual grade.

Scottish Standard Grades comprised a mixture of assessed coursework and examinations (Scottish Qualifications Authority 2009). Standard Grades were assessed separately by subject, and a subject-specific Standard Grade was awarded on a seven point scale (Raffe et al. 1999). Pupils typically studied for around seven or eight Standard Grades over the final two years of compulsory education (Brisard and Menter 2008). We adopt the terminology 'outcomes' to reflect the fact that Standard Grades are a confection of pupil choices, parental choices, teachers' decisions, institutional constraints and opportunities (e.g. the organisation of the school's timetable), and the pupil's resulting performance in the Standard Grade subjects for which they are examined.

In the period covered by the data there were more than thirty different Standard Grade subjects available throughout Scotland. There were no compulsory or specified sets of Standard Grades for which a pupil must study, although in some earlier periods certain subjects such as Mathematics, English and a Foreign Language were compulsory (Croxford 1994a, Gavin 2003, Brisard and Menter 2008). Pupils and parents were given a large degree of choice over which subjects a pupil studied. These choices were made under the guidance of teachers and within the constraints of the subjects offered by the pupil's school. The subjects selected were also constrained by the combination of subjects allowed by the school timetable (Croxford 1994a, b). An example of the choices available to pupils at one school (Knightswood Secondary School in Glasgow, 2015) are depicted in Figure 1.

THE SECONDARY EDUCATION FOR S3 AND S4 PUPILS

COMPULSORY

1. English
2. Mathematics
3. History or Geography or Modern Studies
4. French

CORE (choice)

5. Biology, Chemistry, Physics, Science

TECHNOLOGY (choice)

6. Computing, Graphic Communication, Administration, Home Economics

CREATIVE (choice)

7. Art, Craft and Design, Dance (S.Q.A. Awards), Music, Physical Education

ELECTIVE (free choice)

8. Art, Chemistry, German, Drama, Physical Education, Accounting and Finance

Physical Education, Religious Studies and Social Education are also part of the Core. Pupils sit a SQA Short courses in Religious Education and achieve a SQA Work Experience Award in Social Education.

Figure 1: Example of Standard Grade Subjects Provided by Knightswood Secondary School, Glasgow.

Source: http://www.knightswoodsecondary.org.uk/curriculum.htm accessed 07/10/15.

Each Standard Grade subject studied was awarded an individual grade on a seven point scale, the highest being grade 1, and the lowest grade 7. To give all pupils access to Standard Grade courses, the examinations were offered at three levels. The highest level was Credit, followed by General and Foundation. Only Pupils who took the Credit level could attain grades 1 or 2 (the highest grades). Pupils who took the General examination could attain a maximum grade of 3, and pupils who took the Foundation examination could attain a maximum grade of 5 (Gamoran 1996).

Because Standard Grades were ungrouped, subject-based, and graded on a 7 point scale there was no single obvious method of summarizing a pupil's overall school Standard Grade outcomes. In Scottish secondary school league tables, schools were

typically ranked by the number of Standard Grade Credit awards (i.e. grades 1 to 2) gained by pupils (Bryce et al. 2003). Government reports have charted the number of pupils who gained Credit level awards, and this outcome measure has been used by researchers (for example Sawkins 2002).

In England, GCSE grades A* to C are routinely used as a mark of quality, and obtaining five or more GCSEs at grades A* to C is a well-recognized benchmark for overall outcomes, which is employed in official statistics and in social research (Leckie and Goldstein 2009). There was no similar quality threshold or overall benchmark for Standard Grades in Scotland. Researchers have sometimes used Standard Grades at grades 1 to 3, particularly when attempting to make comparisons with pupils who gained GCSE grades A* to C in the rest of the UK (Anderson et al. 2004). A limitation of measures such as the number of Standard Grades at grades 1 to 3 can be illustrated simply. The measure will count a grade 1 in Mathematics equally with a grade 2 in Art and a grade 3 in Physical Education. Gorard and Taylor (2002) point out a similar limitation with measures of GCSE outcomes, for example an A* in Sociology, a B in Physics and a C in Dance would be counted equally when the determining whether or not a pupil has five GCSEs at grades A*-C.

We contend that there are an infinite number of scores that could be ascribed to the seven ordered Standard Grade categories (although some would be more sensible than others). Croxford, Iannelli, and Shapira (2007) formulated a points score measure in order to summarize a pupil's overall school Standard Grade outcomes. In their scheme a grade 1 is awarded 7 points and a grade 7 is awarded 1 point. We adopt this scoring approach in the analyses below because we consider that this is substantively sensible. We also note that it is in line with an approach previously advocated by the Qualifications and Curriculum Authority (QCA) for GCSEs[4].

[4] In the early 2000s the QCA developed a new scoring system which awarded an A* 58 points, an A 52 points, a B 46 points, a C 40 points, a D 34 points, an E 28 points, a F 22 points, and a G 16 points (see http://webarchive.nationalarchives.gov.uk/20130123124929/http://www.education.gov.uk/performancetables/nscoringsys.shtml#sc accessed 29/02/16). The Scottish Government have reported data using the Unified Points Score Scale, which is another alternative. This measure was an extended version of the Universities and Colleges Admissions Service (UCAS) Scottish Tariff points system. The scale ranged from 3 points for a grade 7 Standard Grade, up to 38 points for a grade 1 Standard Grade (see http://www.gov.scot/Publications/2009/03/09154229/3 accessed 29/02/16).

We use the term 'agglomerate' measures to describe overall measures of outcomes in school Standard Grades. In the analyses below we report a range of agglomerate measures, and concentrate on exploring 'middle' levels of performance in school Standard Grades. A central challenge of our programme of work is developing a methodological strategy to handle the messiness and complexity of individual pupil's school Standard Grade outcomes, and we turn our attention to this challenge in the second half of the paper.

5. DATA

Historically social scientists have only had highly restricted access to administrative records, however it is becoming increasingly common for administrative data to be linked to existing large-scale social survey datasets. The ESRC have funded the Administrative Data Research Network (ADRN) which aims to appropriately open up access to a plethora of data that have previously been inaccessible. The goal is to provide researchers with access to data from Government Departments and other agencies that routinely collect data relevant to social research.

Improvements to the accessibility of data on young people and educational outcomes in Scotland is welcome because a gap was left by the discontinuation of the Scottish School Leavers Survey (see Croxford 2009). School outcomes data for young people in the British Cohort Study (BCS70), who were born in 1970, is now outdated for most analyses. Participants in the Millennium Cohort Study and Growing Up in Scotland have not reached the end of compulsory education and have not undertaken school qualifications (see Connelly and Platt 2014, Anderson et al. 2007).

A specialist dataset using administrative records was constructed for this project (SLS Project Number 2014_005)[5]. The dataset comprises young people who undertook Standard Grades in Scottish schools between 2007 and 2011 who were members of the Scottish Longitudinal Study (SLS). The SLS is a large-scale, anonymised linkage study, consisting of a representative 5% sample of the Scottish population. It links decennial Census records (from 1991, 2001 and 2011) to other administrative data resources (see

[5] See http://sls.lscs.ac.uk/projects/view/2014_005/ accessed 27/10/15.

Boyle et al. 2009). Details of the Scottish Qualifications Authority (SQA) data that are held as part of the SLS are provided by Raab (2013).

This specialised dataset therefore provides an important research resource for studying Scottish young people and their educational outcomes, and it partially plugs the gap in the existing portfolio of social science datasets. The wider SLS data structure provides parental and household information, although there are fewer relevant variables than would ordinarily be available within a social science dataset (for example the Youth Cohort Study of England and Wales).

There have been a wealth of studies which have explicitly investigated the hierarchical structure of educational data (for a review, see Connelly, Sullivan, and Jerrim 2014). Studies that have examined the influence that school-level and individual-level factors have on educational attainment have demonstrated that the majority of variation in attainment is at the pupil-level (Reynolds et al. 1996, Sammons 1999, OECD 2007). Rasbash et al. (2010) estimated that up to eighty percent of variance in school educational attainment can be attributed to the pupil level. The Programme for International Student Assessment (PISA) provides valuable insights. Analyses of PISA data confirm that little of the variation in pupils' attainment in Scotland is associated with the ways in which schools differ, most of the variation is connected with how children differ, and who you are in Scotland is far more important than what school you attended (OECD 2007). There are no school-level or Local Authority-level indicators in the linked SQA data, and therefore it is only possible to undertake single-level (i.e. pupil-level) analyses.

6. RESULTS

Table 1 reports some agglomerate measures for our analytical sample. Twenty seven percent of the pupils were awarded no Standard Grades at Credit level. Thirty two percent of pupils were awarded five or more Standard Grades at Credit level. Forty percent of pupils were awarded between 1 and 4 Standard Grades at Credit level, and we initially theorise that this represents a 'middle' or 'moderate' level of school Standard Grade outcomes.

Pupils Mean Number of Standard Grades Studied	6.2
Pupils Mean Points Score per Standard Grade Studied	5.3
Pupils Mean Standard Grades Points Score	32.5
	Percentage of Pupils
0 Standard Grade Credit Passes (grades 1-2)	27%
1-4 Standard Grade Credit Passes (grades 1-2)	40%
5+ Standard Grade Credit Passes (grades 1-2)	32%

Table 1: Agglomerate Measures of Standard Grade Outcomes, 2007-2011

Source: Scottish Longitudinal Study[6], n=9,032

[6] The SQA data represented all of the pupils that undertook school Standard Grades in Scotland. The analyses presented in this paper are unweighted because the data are not from a conventional sample survey.

Number of Standard Grade Credit Passes	0	1-4	5+		n
Year					
2007	29%	38%	33%	**100%**	2,347
2008	27%	40%	34%	**100%**	2,242
2009	27%	41%	31%	**100%**	2,204
2010	26%	42%	32%	**100%**	2,239
Gender					
Male	30%	41%	29%	**100%**	4,670
Female	25%	39%	36%	**100%**	4,362
Household Type					
Both Parents	23%	40%	37%	**100%**	6,794
Mother Only	41%	41%	18%	**100%**	2,125
Father Only	39%	38%	23%	**100%**	113
Parental Socioeconomic Position (NS-SEC) [7]					
1.1 Large employers and higher managerial	10%	36%	53%	**100%**	606
1.2 Higher Professionals	6%	28%	67%	**100%**	613
2 Lower managerial and professional	16%	38%	45%	**100%**	2,402
3 Intermediate	24%	45%	31%	**100%**	1,288
4 Small employers and own account	28%	45%	27%	**100%**	651
5 Lower supervisory and technical	32%	48%	20%	**100%**	805
6 Semi-routine	42%	43%	15%	**100%**	1,329
7 Routine	50%	38%	12%	**100%**	772
Parental Highest Qualification[8]					
First degree/higher degree	11%	33%	56%	**100%**	2,357
HNC/HND	20%	41%	39%	**100%**	941
Highers/CSYS/A-levels	21%	44%	35%	**100%**	1,591
O Grade/Standard Grade	35%	45%	19%	**100%**	2,779
No Qualifications	53%	38%	10%	**100%**	1,219
Unknown	54%	33%	13%	**100%**	145
Observations	2,471	3,633	2,928		9,032

Table 2: School Standard Grade Outcomes by Pupils' Characteristics 2007-2010 (Row Percentages)

Source: Scottish Longitudinal Study, n=9,032.

Note: All pupils gaining a Standard Grade pass at grades 1-7.

Table 2 reports school Standard Grade outcomes by pupils' characteristics. In the next stage of the analysis we estimate a multinomial logistic regression model with a set of similar explanatory variables used by Croxford (2009), Gayle, Murray, and Connelly (2014), Croxford (2015) and Playford and Gayle (2016). The results of the multinomial logistic regression model are reported in Table 3.

[7] Parental socioeconomic position was measured by the highest category of NS-SEC of either parent in 2001.

[8] Parental highest qualification was measured by the highest qualification attained by either parent in 2001.

	B	SE	Quasi SE	Predictive Margin	Pred. SE
0 Credit Passes / 1-4 Credit Passes					
Year					
2007	0.00	(0.00)	0.05	0.00	0.00
2008	-0.12	(0.08)	0.06	-0.02	0.01
2009	-0.16*	(0.08)	0.06	-0.02	0.01
2010	-0.23**	(0.08)	0.06	-0.03	0.01
Gender					
Female	0.00	(0.00)	-	0.00	0.00
Male	0.17**	(0.06)	-	0.05	0.01
Household Type					
Lives with both parents	0.00	(0.00)	0.04	0.00	0.00
Lives with mother only	0.06	(0.07)	0.06	0.03	0.01
Lives with father only	0.13	(0.25)	0.25	0.02	0.04
Parental Socioeconomic Position (NS-SEC)					
1.1 Large employers and higher managerial	0.20	(0.23)	0.15	0.04	0.02
1.2 Higher professionals	0.00	(0.00)	0.19	0.00	0.00
2 Lower managerial and professional	0.56**	(0.20)	0.07	0.10	0.02
3 Intermediate	0.64**	(0.21)	0.07	0.13	0.02
4 Small employers and own account	0.71***	(0.21)	0.10	0.15	0.02
5 Lower supervisory and technical	0.77***	(0.21)	0.08	0.18	0.02
6 Semi-routine	1.02***	(0.21)	0.06	0.24	0.02
7 Routine	1.25***	(0.21)	0.08	0.28	0.03
Parental Highest Qualification					
First Degree/Higher Degree	0.00	(0.00)	0.08	0.00	0.00
HNC/HND	0.33**	(0.12)	0.09	0.08	0.02
Highers/CSYS/A-levels	0.16	(0.11)	0.07	0.05	0.01
O Grade/Standard Grade	0.55***	(0.10)	0.05	0.15	0.01
No Qualifications	0.95***	(0.12)	0.07	0.26	0.02
Unknown	1.45***	(0.40)	0.39	0.26	0.07
Constant	-1.64***	(0.20)	-	-	-
1-4 Credit Passes					
Year					
2007	0.00	(0.00)	-	0.00	0.00
2008	0.00	(0.00)	-	0.01	0.01
2009	0.00	(0.00)	-	0.03	0.01
2010	0.00	(0.00)	-	0.05	0.01
Gender					
Female	0.00	(0.00)	-	0.00	0.00
Male	0.00	(0.00)	-	0.02	0.01
Household Type					
Lives with both parents	0.00	(0.00)	-	0.00	0.00
Lives with mother only	0.00	(0.00)	-	0.03	0.01
Lives with father only	0.00	(0.00)	-	-0.01	0.05
Parental Socioeconomic Position (NS-SEC)					
1.1 Large employers and higher managerial	0.00	(0.00)	-	0.05	0.03
1.2 Higher professionals	0.00	(0.00)	-	0.00	0.00
2 Lower managerial and professional	0.00	(0.00)	-	0.05	0.02
3 Intermediate	0.00	(0.00)	-	0.08	0.03
4 Small employers and own account	0.00	(0.00)	-	0.09	0.03
5 Lower supervisory and technical	0.00	(0.00)	-	0.12	0.03
6 Semi-routine	0.00	(0.00)	-	0.08	0.03
7 Routine	0.00	(0.00)	-	0.05	0.03

Table 3: Multinomial Logistic Regression Model Results – Standard Grade Credit Passes (0, 1-4 and 5+).

Source: Scottish Longitudinal Study.

Notes: Conventional standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	B	SE	Quasi SE	Predictive Margin	Pred. SE
Parental Highest Qualification					
First Degree/Higher Degree	0.00	(0.00)	-	0.00	0.00
HNC/HND	0.00	(0.00)	-	0.04	0.02
Highers/CSYS/A-levels	0.00	(0.00)	-	0.07	0.02
O Grade/Standard Grade	0.00	(0.00)	-	0.08	0.02
No Qualifications	0.00	(0.00)	-	0.04	0.02
Unknown	0.00	(0.00)	-	-0.13	0.07
Constant	0.00	(0.00)	-	-	-
5+ Credit Passes / 1-4 Credit Passes					
Year					
2007	0.00	(0.00)	0.05	0.00	0.00
2008	-0.01	(0.07)	0.05	0.01	0.01
2009	-0.13	(0.08)	0.05	-0.02	001
2010	-0.18*	(0.08)	0.05	-0.02	0.01
Gender					
Female	0.00	(0.00)	-	0.00	0.00
Male	-0.33***	(0.05)	-	-0.07	0.01
Household Type					
Lives with both parents	0.00	(0.00)	0.04	0.00	0.00
Lives with mother only	-0.26**	(0.08)	0.07	-0.05	0.01
Lives with father only	-0.01	(0.29)	0.28	-0.01	0.01
Parental Socioeconomic Position (NS-SEC)					
1.1 Large employers and higher managerial	-0.35**	(0.13)	0.09	-0.09	0.03
1.2 Higher professionals	0.00	(0.00)	0.10	0.00	0.00
2 Lower managerial and professional	-0.52***	(0.10)	0.05	-0.15	0.03
3 Intermediate	-0.78***	(0.12)	0.07	-0.21	0.03
4 Small employers and own account	-0.91***	(0.14)	0.10	-0.24	0.03
5 Lower supervisory and technical	-1.22***	(0.14)	0.10	-0.30	0.03
6 Semi-routine	-1.20***	(0.14)	0.09	-0.32	0.03
7 Routine	-1.18***	(0.16)	0.13	-0.33	0.03
Parental Highest Qualification					
First Degree/Higher Degree	0.00	(0.00)	0.05	0.00	0.00
HNC/HND	-0.41***	(0.09)	0.08	-0.12	0.02
Highers/CSYS/A-levels	-0.48***	(0.08)	0.06	-0.12	0.02
O Grade/Standard Grade	-0.90***	(0.08)	0.06	-0.23	0.02
No Qualifications	-1.20***	(0.13)	0.12	-0.30	0.02
Unknown	-0.00	(0.47)	0.47	-0.14	0.08
Constant	1.27***	(0.11)	-	-	-
n	8466				
Log likelihood	-8271.51				
McFadden's Adjusted R-squared	0.09				
BIC	-59370.745				
BIC'	-1454.297				

Table 3 (Continued): Multinomial Logistic Regression Model Results – Standard Grade Credit Passes (0, 1-4 and 5+).

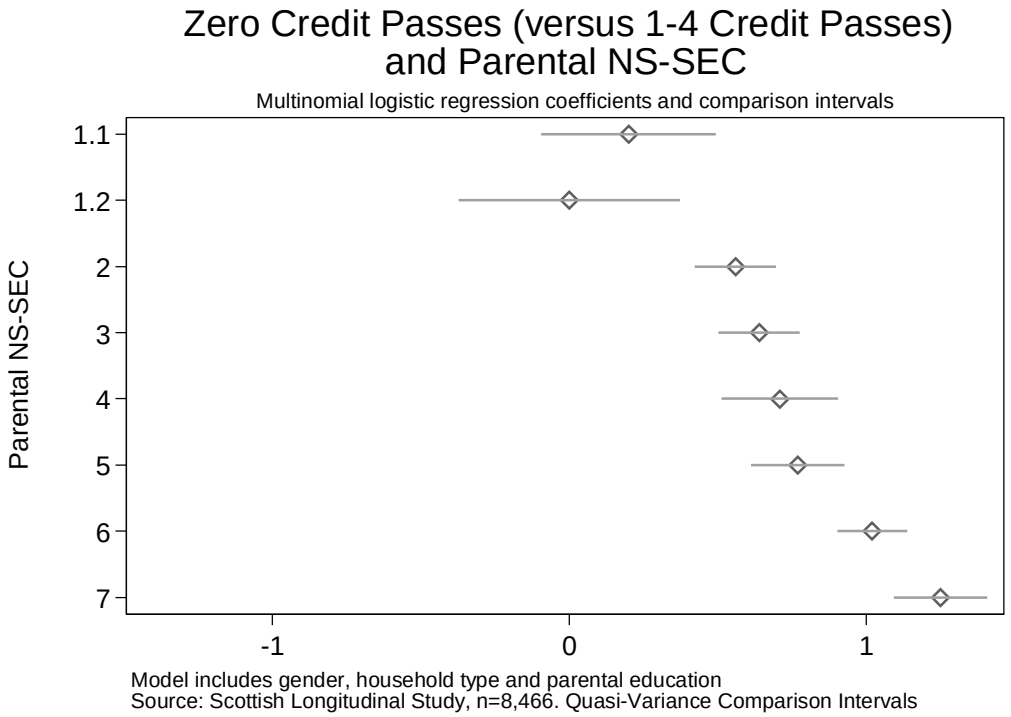
Source: Scottish Longitudinal Study.

Notes: Conventional standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

There is a longstanding observation that female pupils have better School Standard Grade outcomes (see Scottish Office 1999, and Tinklin 2003). We find that male pupils had higher log odds of having zero Credit passes rather than 1-4 Credit passes, but lower log odds of having 5+ Credit passes rather than 1-4 passes. Our finding supports the frequent observation of the underperformance of male pupils (for example see

Biggart 2000, Warrington and Younger 2000, Gayle, Berridge, and Davies 2003, Burgess et al. 2004, Younger and Warrington 2005, Connolly 2006, Department for Education and Skills 2007).

The association between parental socioeconomic position and filial educational outcomes is well observed (see Drew, Gray, and Sime 1992, Drew 1995, Demack, Drew, and Grimsley 2000, Gayle, Berridge, and Davies 2003, Connolly 2006, Gayle, Lambert, and Murray 2009, Gayle, Murray, and Connelly 2014). In the Scottish data we find a general negative relationship and pupils with parents in less advantaged socioeconomic groups generally had poorer Standard Grade outcomes. Figure 2 provides a graphic illustration of the relationship between parental socioeconomic position and filial Standard Grade outcomes. Pupils from more advantaged families generally have better outcomes. The poorer performance of pupils from routine and manual socioeconomic groups (i.e. NS-SEC 5-7) is clearly illustrated. A more subtle result is that whilst there is a general negative relationship the less advantaged socioeconomic groups are not significantly different from each other. This suggests that in practice the important differences within these agglomerate Standard Grade outcomes might lie between larger groupings. By which we mean the differences between pupils from families with parents in higher managerial, administrative and professional occupations (NS-SEC 1.1, 1.2 and 2), intermediate occupations (NS-SEC 3 and 4) and routine and manual occupations (NS-SEC 5-7).



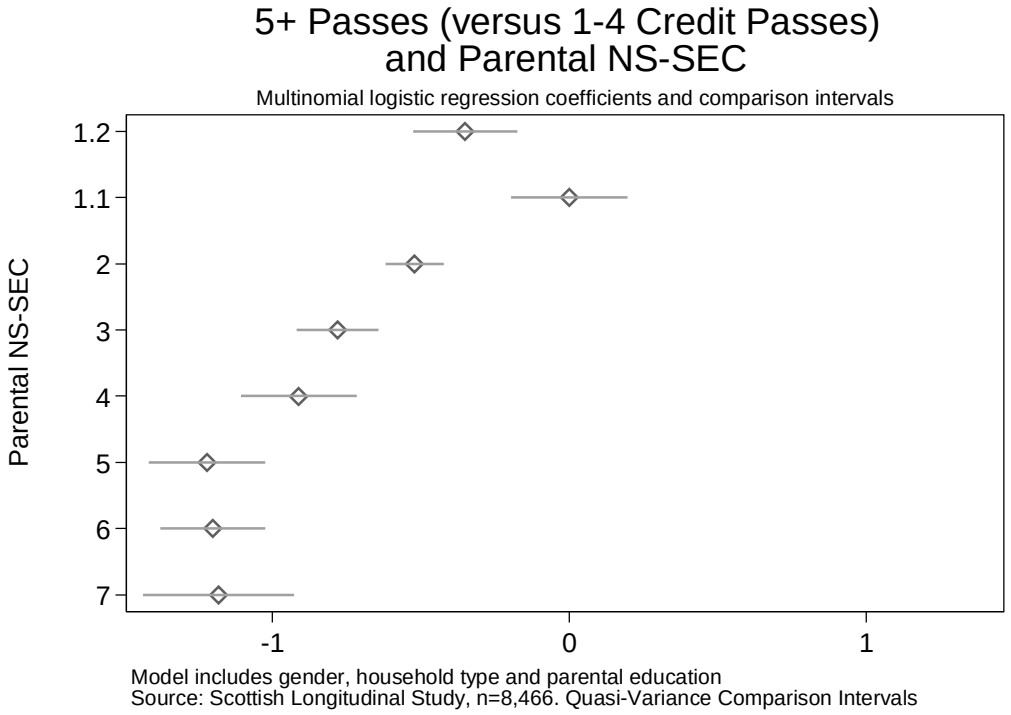


Figure 2: Multinomial Logistic Regression Model Coefficients (and 95% Quasi-Variance Comparison Intervals) - Parental Socioeconomic Positions (NS-SEC).

Notes: 1.1 Large employers and higher managerial; 1.2 Higher professionals; 2. Lower managerial and professional; 3. Intermediate; 4 Small employers and own account; 5. Lower supervisory and technical; 6. Semi-routine; 7. Routine.

The analyses above confirm that there was a 'middle' group of pupils with 'moderate' or unspectacular school Standard Grade outcomes. These agglomerate school Standard Grade outcomes were stratified by gender and parental socioeconomic position, and to a lesser extent parental education and household type. We have outlined the problem of measuring school Standard Grade outcomes and conclude that for many analyses a categorical agglomerate measure of school Standard Grade outcomes will be both adequate and functional. We are mindful that whilst 1-4 Credit passes is highly plausible it is only one of several possible ways of measuring 'middle' or 'moderate' outcomes. For many analyses categorical agglomerate measures of educational outcomes, such as school Standard Grades or GCSEs, will be sufficient. More generally, we would caution that thought should be put into whether or not these measures represent discrete substantively meaningful categories, or whether they might be better considered as being coarse groupings of a scale. In the next section of the analyses we turn our attention to the development and application of a latent variable approach as a methodological solution to the challenge of measuring and analysing school Standard Grade outcomes.

7. LATENT VARIABLE MODELS

A central challenge of our programme of work is developing a methodological strategy to handle the messiness and complexity of individual pupil's outcomes in school qualifications. A hypothetical set of choices and outcomes for a small group of pupils is illustrated in Figure 3. The figure depicts the differences in both Standard Grade subjects studied and grades awarded, and should convey the complexity of reducing these results to a single, substantively meaningful, agglomerate measure.

	Scottish Standard Grade Subject											
Pupil	English	Maths	Biology	Chemistry	Physics	Science	History	Geography	French	German	Spanish	Art
Scott	1	1	1	1			1		1			1
Virgil	2	2		2	2			2			2	
Alan	3	3				3	3	3				
Gordon	7	7				7			6			3
Tin-Tin	1	1	1	1					1	1		
Penelope	1	2	1		1		1					2

Figure 3: Example of Various Standard Grade Subject-Level Outcomes for a Set of Hypothetical Pupils.

Latent class models relate a set of observed (usually categorical) variables to a set of latent or unmeasured classes (McCutcheon 1987, Clogg 1995, McCutcheon 1996, Becker and Yang 1998, McCutcheon 2002). Latent class models explore the patterning of categorical outcomes across a number of observed measures. Playford and Gayle (2016) demonstrate the utility of these models for investigating subject-area school GCSE outcomes. Following Playford and Gayle (2016), because the term 'class' is used within education to denote forms or classrooms, and is also used as a short-hand for social class, from this point onwards we use the term 'latent group' rather than 'latent class' to avoid confusion. A general schema of a latent group (class) model of subject-area school Standard Grade outcomes is provided in Figure 4.

Latent group models provide a multivariate approach to analysing complex arrays of inter-related categorical data, and offer great potential for the analysis of school Standard Grade outcomes. As we noted there is no single recognised quality standard for school Standard grades but gaining a Credit pass is used, and it is a good indicator of participation in post-compulsory education (Tinklin 2003). In the analyses below we classified a pupil's subject-area Standard Grade outcomes as a series of binary outcomes (where a Credit pass equals 1, and a non-Credit pass equals 0).

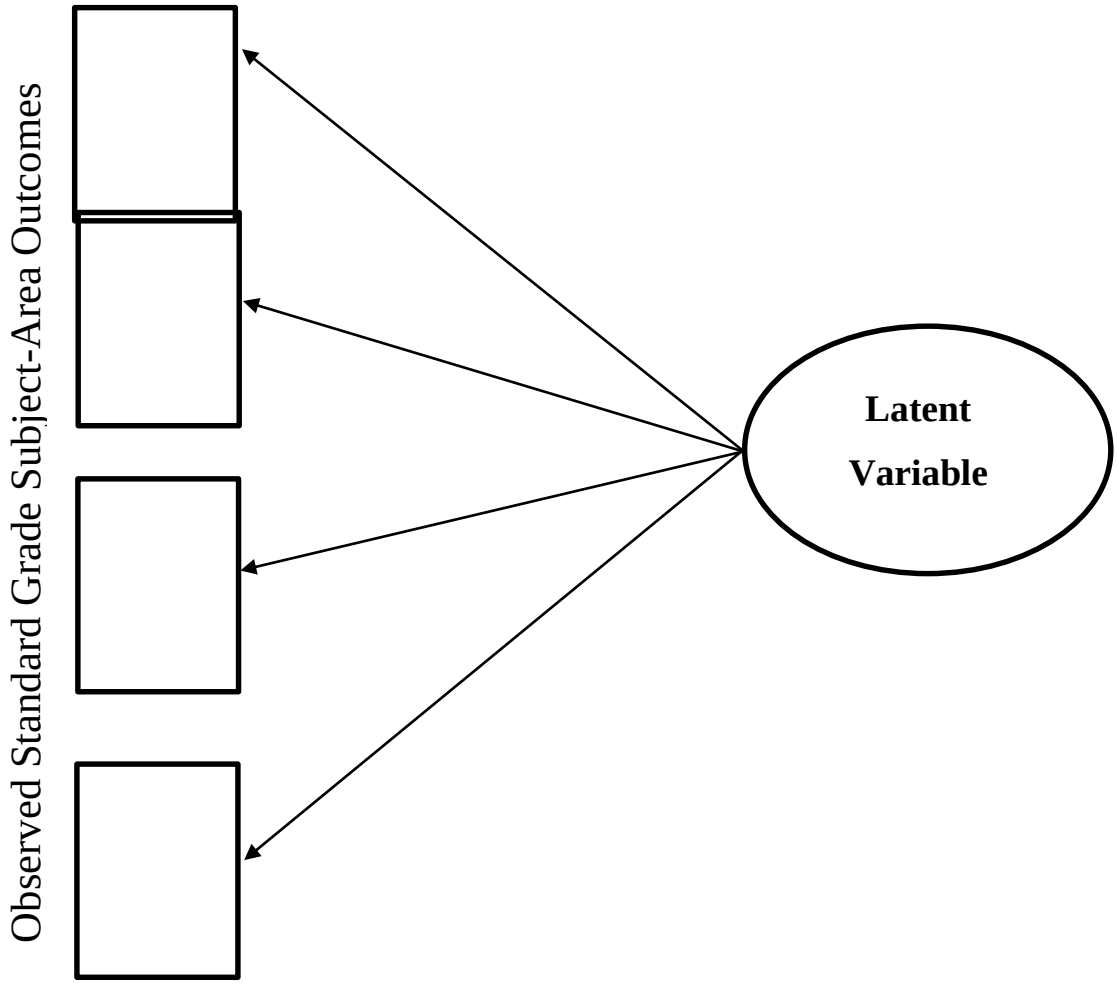


Figure 4: General Schema of a Latent (Class) Group Analysis of Subject-Area School Standard Grade Outcomes.

Given the large number of Standard Grade subjects which were available to pupils, and potential subject combinations, a process of categorisation is essential to effectively operationalise the analysis. Table 4 lists the major subject groupings into which individual Standard Grade subjects have been classified. These broadly follow the modes of study outlined by the Scottish Consultative Council on the Curriculum (for details see Gavin 2003).

Subject Groups	Standard Grades	Number of pupils gaining grades 1-7
English	English	**7,725**
Mathematics	Mathematics	**6,959**
Sciences	Biology; Chemistry; Physics; Science	**6,479**
Humanities	Classical Studies; Contemporary Social Studies; Economics; Geography; History; Latin; Modern Studies; Religious Studies	**7,527**
Languages	French; Gaidhlig; Gaelic (Learner); German; Italian; Spanish; Urdu	**5,761**
Creative Arts	Art; Drama; Music	**3,840**
Other Subjects	Physical Education; Accounting and Finance; Administration; Computing Studies; Craft and Design; Graphic Communication; Home Economics; Social and Vocational Studies; Technological Studies; Business Management	**7,295**
Total		**9,032**

Table 4: Year S4 School Standard Grade Subject Groups and Component Standard Grade Subjects.

Source: Scottish Longitudinal Study, n=9,032.

A benefit of latent group models is that they are appropriate as a means of modelling highly correlated observed variables. Table 5 reports the correlations between Credit level passes in the 7 main subject area groupings. For example, gaining a Credit pass in Science is highly correlated with gaining a Credit pass in Maths (0.81) but the correlation between gaining a Credit pass in English and a Credit pass in Creative Arts is much weaker (0.47).

	English	Mathematics	Sciences	Humanities	Languages	Creative Arts	Other Subjects
English	1.00						
Mathematics	0.69	1.00					
Sciences	0.66	0.81	1.00				
Humanities	0.70	0.71	0.76	1.00			
Languages	0.68	0.71	0.71	0.68	1.00		
Creative Arts	0.47	0.36	0.37	0.43	0.43	1.00	
Other Subjects	0.44	0.49	0.50	0.51	0.39	0.11	1.00

Table 5: School Standard Grade Outcomes (Year S4) - Tetrachoric Correlations.
Source: Scottish Longitudinal Study, n=9,032.

A major attraction of applying this modelling approach is that individuals can be assigned to latent groups based on the observed outcomes (see Bartholomew et al. 2008). Table 6 reports the summary statistics for a nested set of latent group models.

Model	LL	Deviance	Δ Deviance	DF	Adjusted BIC	Relative Scaled Entropy
2 Group	-32886.7	1500.0	-	112	1588.5	0.85
3 Group	-32418.9	563.9	936.1	104	700.3	0.72
4 Group	-32294.8	315.6	248.3	96	499.5	0.70
5 Group	-32243.3	212.7	102.9	88	444.0	0.69
6 Group	-32212.8	151.7	60.0	80	430.5	0.63
7 Group	*Model did not converge*					

Table 6: Latent Educational Group Models (Goodness of Fit Statistics)

Source: Scottish Longitudinal Study, n=9,032

A single categorical latent variable was estimated[9]. Post-estimation we have ascribed a label to each of the latent groups which describes the overall substantive pattern of school Standard Grade outcomes. Nylund et al. (2007) emphasize that theory should be a central criterion when deciding on the number of groups within a latent group model. The four group model uncovers a latent group with low outcomes, a latent group with high outcomes and two latent groups with 'middle' or 'moderate' school Standard Grade outcomes. The four group model resonated with the four group model of school GCSE subject-area outcomes that was reported by Playford and Gayle (2016). The five and six group models could be preferred on the grounds that the adjusted BIC statistic indicates that they are more parsimonious than the four group model. However, the relative scaled entropy measure[10] indicates that there is a decrease in classification certainty in the five and six group models.

Table 7 reports patterns of assignment to latent groups in the four group model and the six group model. There is a high level of agreement (62%; Kappa=.49) between assignment to the four and the six group model. The additional latent groups in the six group model can reasonably be considered as further subdivisions of the group of pupils with the highest Standard Grade outcomes in the four group model.

Informal feedback from both academic and non-academic audiences encourages us that the more parsimonious four group model is more easily communicated and more

[9] The models were fitted using the LCA plugin for Stata 13 (StataCorp 2013, LCA Stata Plugin (Version 1.2) [Software] 2015, Lanza et al. 2015).

[10] Entropy measures the ability of a mixture model (e.g. latent variable model) to provide well separated groups (Celeux and Soromenho 1996).

readily understood[11]. We therefore conclude that whilst the additional latent groups might be informative for some analyses, they do not greatly contribute to an improved understanding of 'middle' outcomes.

	Four Group Model				
Six Group Model	**1 'Low Outcomes'**	**2 'Middle Non-Science'**	**3 'Middle Science'**	**4 'High Outcomes'**	
					Total
1 'Low Outcomes'	89	0	0	0	40
2 'Middle Non-Science'	11	69	30	0	19
3 'Middle Science'	0	10	69	10	14
4 'High Non-Science & Poor Mathematics'	0	12	0	7	3
5 'High Poor Mathematics'	0	9	0	17	6
6 'High Outcomes'	0	0	0	66	18
(column percentage)	100	100	100	100	100
Pearson's Chi-Square = 16,000; p≤.001; Cramér's V = .76 Agreement 62%; Expected Agreement 24%; Kappa = .49					

Table 7: Latent Group Models (Modal Assignment) Four Group Model and Six Group Model

Source: Scottish Longitudinal Study, n=9,032.

Table 8 reports agglomerate Standard Grade outcome information for each of the four latent educational groups. Pupils in group 1 have the poorest outcomes. Sixty percent of pupils in group 1 gained no Credit passes at Standard Grade. Pupils in group 1 gained on average less than 1 credit pass and had an average score of 22 points. This contrasts sharply with pupils in group 4, where 95% gained 5+ Credit pass Standard Grades. Pupils in group 4 on average achieved 6.6 Credit passes, and had an average point score of 46.

The overall Standard Grade outcomes are similar for latent groups 2 and 3. The majority of pupils in group 2 (79%) and group 3 (70%) gained 1-4 Credit passes. Pupils in group 2 typically gained 3.4 Credit passes compared with 3.8 for pupils in group 3. Group 2 and group 3 have nearly identical point scores. These agglomerate measures strongly suggest that pupils in groups 2 and 3 have 'middle' or 'moderate' school Standard Grade outcomes.

[11] We are grateful for comments received from audiences at the following presentations, Playford et al. (2015a), Playford et al. (2015b), and Playford et al. (2015c). Results of the six group model are provided in Appendix 1.

Latent Group	1 "Low Outcomes"	2 "Middle Non-Science"	3 "Middle Science"	4 "High Outcomes"	All
0 Standard Grade Credit Passes (grades 1-2)	60%	0%	0%	0%	27%
1-4 Standard Grade Credit Passes (grades 1-2)	40%	79%	70%	5%	40%
5+ Standard Grade Credit Passes (grades 1-2)	0%	21%	30%	95%	32%
Pupils Mean number of Standard Grade Credit Passes (grades 1-2)	0.5	3.4	3.8	6.6	3.0
Pupils Mean Standard Grades Points Score	22.1	35.9	36.6	46.2	32.5
Pupils Mean Number of Standard Grades Studied	5.3	6.6	6.5	7.2	6.2
Pupils Mean Points Score per Standard Grade Studied	4.2	5.4	5.6	6.4	5.3

Table 8: Agglomerate Measures of School Standard Grade Outcomes by Latent Group (4 Group Model)

Source: Scottish Longitudinal Study, n=9,032

Note: All pupils gaining a Standard Grade pass at grades 1-7

Figure 5 illustrates the results of the four category latent group model of subject-area school Standard Grade outcomes[12]. In this model, there are seven observed variables measuring outcomes in English, Mathematics, Sciences, Humanities, Languages, Creative Arts and Other Subjects. Each variable is binary (Credit pass equals 1, and a non-Credit pass equals 0). The posterior (group) and prior (item) probabilities estimated in the modelling process are reported (for further details see Bartholomew et al. 2008, 273). Pupils were allocated to latent educational groups through modal assignment.

Forty six percent of pupils were assigned to group 1 (low outcomes), 14% to group 2 (middle non-science), 14% to group 3 (middle science) and 27% to group 4 (high outcomes) (see Table 13). Latent group 1 had a low probability of gaining Credit passes in all subject-areas. Conversely, latent group 4 were characterised by a high probability of gaining a Credit pass in all subject-areas. Latent groups 2 and 3 comprise pupils who had 'middle' levels of subject-area school Standard Grade outcomes. These findings mirror the two groups of middle GCSE outcomes identified in Playford and Gayle (2016).

[12] The results of the four group model are presented below in Appendix 1 in tabular form to aid comparison with the results of the six group model.

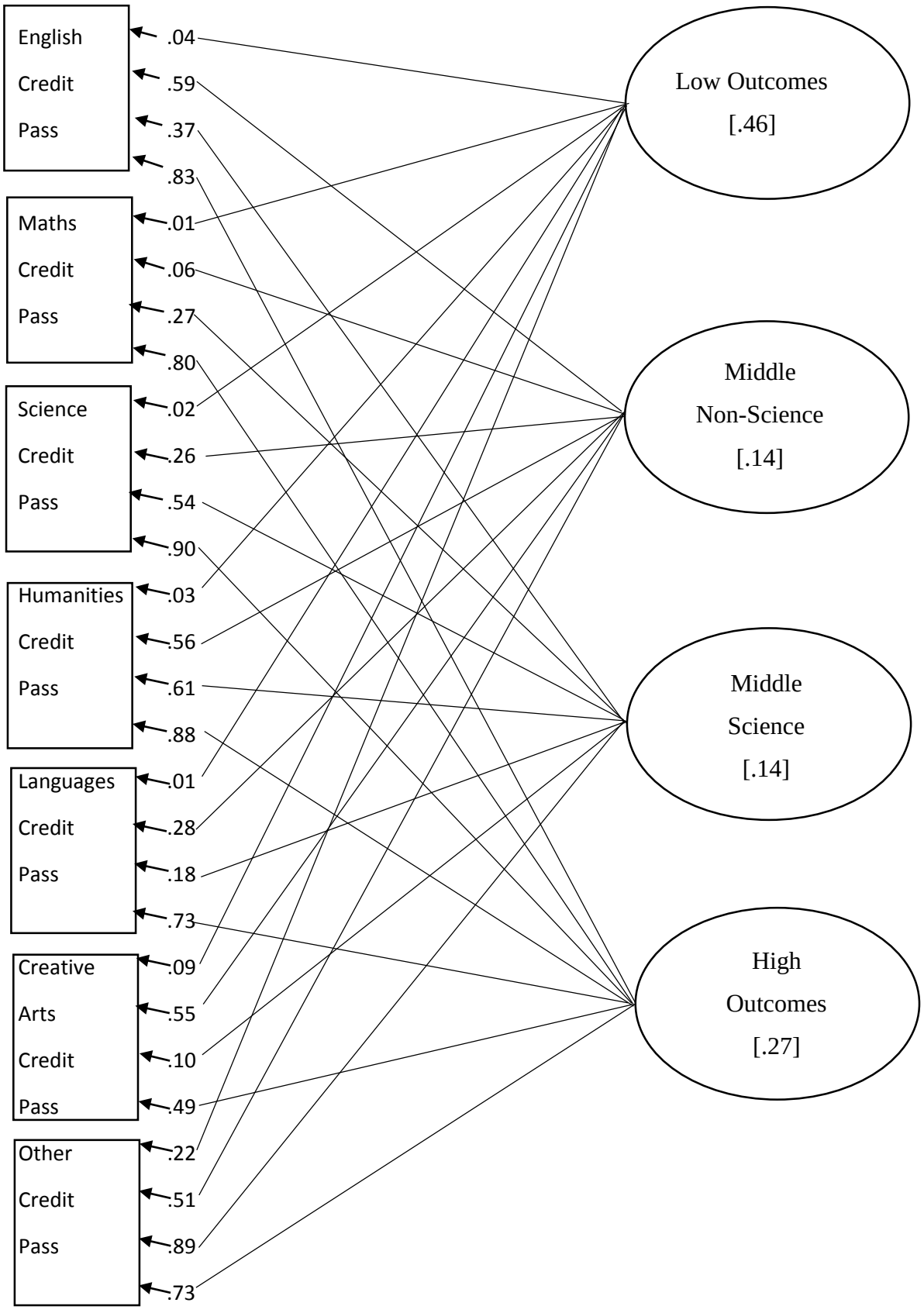


Figure 5: Latent Group Model Results (Four Group Model) School Subject-Area Standard Grade Outcomes – Prior Probabilities and Posterior Probabilities of Latent Group Assignment.

Source: Scottish Longitudinal Study

Notes: All pupils gaining a Standard Grade pass at grades 1-7, n=9,032.

A striking feature of the school subject-area Standard Grades outcomes for pupils in the two 'middle' latent groups, were their relatively poor outcomes in English, Mathematics and Science. Fifty nine percent of pupils in latent group 2 gained a Credit pass in English compared with 37% in latent group 3. Six percent of pupils in latent group 2 gained a Credit pass in Mathematics compared with 27% in latent group 3. Twenty six percent of pupils in latent group 2 gained a Credit pass in Science compared with 54% in latent group 3. These substantive results have led us to theorise that latent group 2 should be ascribed the label 'middle non-science', and latent group 3 'middle science'.

Pupils in the two 'middle' latent groups had more favourable outcomes in the humanities and 'other' subjects, however their outcomes in languages were also poor. The relatively good outcomes of pupils in latent group 2 in Creative Arts is a more subtle finding. Outcomes in Languages and Creative Arts are generally lower across all latent groups, and this was partially a function of fewer pupils studying these subjects (see Table 4).

An attraction of latent variable modelling is that pupils can be assigned to latent educational groups. The results presented above used modal assignment and we are aware that a discussion of alternative methods of assignment is emerging (see Vermunt 2010, Bakk, Tekle, and Vermunt 2013, Asparouhov and Muthén 2014, Heron et al. 2015). Heron et al. (2015) recently suggested the proportional assignment approach as a practicable alternative to modal assignment. With the explicit aim of executing appropriate post-estimation model exploration, we have taken the innovative methodological step of performing a comparison of the two assignment approaches. Table 9 compares assignment to latent groups using each method.

	Four Group Model (Modal Assignment)				
Four Group Model (Proportional Assignment)	**1 'Low Outcomes'**	**2 'Middle Non-Science'**	**3 'Middle Science'**	**4 'High Outcomes'**	
					Total
1 'Low Outcomes'	91	7	5	0	42
2 'Middle Non-Science'	6	70	18	5	16
3 'Middle Science'	3	14	66	7	15
4 'High Outcomes'	0	9	12	88	27
(column percentage)	100	100	100	100	100
Pearson's Chi-Square = 13,000; p≤.001; Cramér's V = .73 Agreement 84%; Expected Agreement 30%; Kappa = .77					

Table 9: Latent Group Models Modal Assignment Four Group Model and Proportional Assignment Four Group Model (Column Percentages).

Source: Scottish Longitudinal Study, n=8,466.

We are confident that in this particular analysis both assignment approaches generally place pupils in the same latent educational groups. There is a strong level of agreement between the two assignment approaches (84%). If the allocation made by each method had been undertaken randomly (but with probabilities equal to the overall proportions), we would expect the two methods to agree on the assignment of 30% of the pupils. We calculated a Kappa value of 0.77 which Landis and Koch (1977) suggest should be interpreted as 'substantial'. We are mindful that the similarity of the results using these two methods could not have been assumed *a priori*. Therefore undertaking more detailed post-estimation exploration, despite being time consuming, has been methodologically informative.

8. INVESTIGATING THE CHARACTERISTICS OF THE LATENT EDUCATIONAL GROUPS

In the next stage of the analysis, we investigated the association between pupil's characteristics and membership of the latent educational groups. Table 10 provides summary information. Membership of the latent educational groups is stratified. There are notable gender differences, with more boys in latent group 1 (low outcomes). There was a strong association with parental socioeconomic position. To a lesser extent latent group membership is also structured by household type and parental education.

Latent Group	1 'Low Outcomes'	2 'Middle Non-Science'	3 'Middle Science'	4 'High Outcomes'		n
Gender						
Male	50%	9%	18%	23%	**100%**	4,670
Female	40%	18%	10%	31%	**100%**	4,362
Household Type						
Both Parents	40%	14%	15%	31%	**100%**	6,794
Mother Only	62%	13%	10%	14%	**100%**	2,125
Father Only	63%	9%	12%	16%	**100%**	113
Parental Socioeconomic Position (NS-SEC)						
1.1 Large employers and higher managerial	23%	13%	18%	45%	**100%**	606
1.2 Higher professionals	13%	15%	15%	57%	**100%**	613
2 Lower managerial and professional	31%	16%	16%	37%	**100%**	2,402
3 Intermediate	43%	16%	16%	24%	**100%**	1,288
4 Small employers and own account	48%	13%	16%	23%	**100%**	651
5 Lower supervisory and technical	58%	11%	14%	17%	**100%**	805
6 Semi-routine	65%	11%	12%	12%	**100%**	1,329
7 Routine	71%	10%	10%	11%	**100%**	772
Parental Highest Qualification						
First degree/higher degree	21%	14%	16%	48%	**100%**	2,357
HNC/HND	37%	17%	14%	32%	**100%**	941
Highers/CSYS/A-levels	41%	14%	17%	28%	**100%**	1,591
O Grade/Standard Grade	57%	14%	14%	15%	**100%**	2,779
No Qualifications	75%	9%	9%	7%	**100%**	1,219
Unknown					**100%**	145
Posterior Probabilities (%)	46%	14%	14%	27%	**100%**	
Observations	4,110	1,225	1,287	2,410		9,032

Table 10: Characteristics of the Latent Educational Groups (Row Percentages)

Source: Scottish Longitudinal Study, n=9,032

Note: All pupils gaining a Standard Grade pass at grades 1-7

We estimated a series of multinomial logistic regression models. Overall summary measures and some goodness-of-fit statistics are reported in Table 11.

Independent Variables	LR	Δ DF	Probability LR	McFadden's Adjusted R2
Null	-	-	-	-
Null + Sex	305.3	3	0.00	0.01
Null + Sex + Household Type	281.7	6	0.00	0.03
Null + Sex + Household Type + Parental Socioeconomic Position (NS-SEC)	1062.1	21	0.00	0.07
Null + Sex + Household Type + Parental Socioeconomic Position (NS-SEC) + Parental Education	422.5	15	0.00	0.09

Table 11: Model Summary Statistics (nested multinomial logistic regression models)

Source: Scottish Longitudinal Study, n=8,466

The results of the full multinomial logistic regression model are reported in Table 12. The outcome variable is the (modal) latent educational group to which the pupil has been assigned[13]. Model estimates have been reported with quasi-variances and predictive margins[14].

Latent educational group membership varies by gender. Males were more likely than females to be in group 1 (low outcomes) compared with group 4 (high outcomes). This finding resonated with the increasingly well-known pattern of girls outperforming boys. Importantly boys have lower log odds of being in latent group 2 (middle non-science) but higher log odds of being in latent group 3 (middle science) compared with latent group 4 (high outcomes). This appears to reflect gender differences in uptake and outcomes in different subjects across the Scottish school curriculum (Croxford 1997, Croxford et al. 2003). Francis (2002) highlights the negative consequences that school subject gender differences have for future educational and employment routes. This finding is important given contemporary concerns about female participation in Science, Technology, Engineering and Mathematics (STEM) subjects in further and higher education, and female participation in associated occupations (Institute of Physics 2013).

Croxford (2015) reports that despite a reduction in inequalities in recent decades, observable socioeconomic differences in the educational outcomes of Scottish pupils persist. In the current analysis, parental socioeconomic position is a very

[13] The output for a multinomial logistic regression model of latent educational groups using proportional assignment are provided in Appendix 1 so that the reader can compare the two sets of results.
[14] For a detailed description of quasi-variance estimation see Gayle and Lambert (2007). For an extended discussion of reporting statistical models, including predictive margins, see Connelly, Gayle, and Lambert (Forthcoming).

important source of difference between pupils in the latent educational groups. Pupils with parents in less advantaged socioeconomic positions are more likely to be in latent group 1 (low outcomes) rather than latent group 4 (high outcomes). This finding is wholly consistent with the routinely detected negative relationship between parental socioeconomic position and filial educational outcomes.

Through the application of the latent variable model, we have detected two distinctive groups with 'middle' or 'moderate' Standard Grade outcomes. An informative finding is that parental socioeconomic position has a different association with membership of these two latent educational groups. Pupils with parents in the Intermediate category (NS-SEC 3) and pupils with parents in the Routine and Manual categories (NS-SEC 5-7) are more likely to be members of latent group 2 (non-science) compared with latent group 4 (high outcomes). These are the children of paramedics (NS-SEC 3), train drivers (NS-SEC 5), tyre fitters (NS-SEC 6) and road sweepers (NS-SEC 7). This finding is particularly important as these pupils have moderate outcomes in English, poor outcomes in Science, and very poor outcomes in Mathematics. Membership of latent group 3 (middle science) follows a more predictable pattern. Compared with pupils with parents in the Higher Professional category (NS-SEC 1.2), pupils with parents in all other categories are more likely to be in latent group 3 (middle science) compared with latent group 4 (high outcomes).

There is a well-established association between parental education and filial educational outcomes (Drew, Gray, and Sime 1992, Drew 1995, Korupp, Ganzeboom, and Van der Lippe 2002, Gayle, Berridge, and Davies 2003, Ermisch and Pronzato 2010, Dickson, Gregg, and Robinson 2013). This association is observed in the analysis of school Standard Grade subject-area outcomes. The children of better qualified parents are more likely to be in latent group 4 (high) compared with all other groups. There is a less well established association between household type and filial educational outcomes (Drew, Gray, and Sime 1992, Gayle, Murray, and Connelly 2014). Pupils who live in lone mother households are more likely to be in latent group 1 (low outcomes) and latent group 2 (middle non-science) compared to latent group 4 (high outcomes). Membership of latent group 3 (middle science) is not significantly associated with household type.

The analyses clearly indicate that there are four distinctive latent educational groups that are characterised by differential subject-area outcomes in Scottish Standard Grades. Two of these latent groups have 'middle' or 'moderate' overall Standard Grade outcomes. Pupils in these two groups have 'ordinary' or unspectacular Standard Grade outcomes. Membership of the latent educational groups is stratified by gender, parental socioeconomic position, parental education, and to a lesser extent, household type. A gender effect has been uncovered which both highlights the well-known poor performance of boys, but also illuminates a more subtle effect on outcomes in English, Mathematics and Science.

The familiar negative effects of lower parental socioeconomic position on overall Standard Grade outcomes are observed. A less predictable association between parental socioeconomic position and membership of latent group 2 (middle non-science) was uncovered. Inadequate performance in English, Science, and Mathematics is a major obstacle for these pupils, and is likely to affect their immediate and longer term educational and occupational outcomes.

The subject-area groupings that we chose broadly followed the modes of study outlined by the Scottish Consultative Council on the Curriculum. We are mindful however that the results partially rest on the way that these Standard Grade subject groups have been organised. We are confident that we have chosen a sensible strategy which was informed by comparative analyses of GCSE results undertaken by Playford and Gayle (2016), and more in-depth exploratory analyses undertaken by Playford (2011). We intend to explore alternative constructions of subject groups in future research. The analyses concentrated on Credit level outcomes because they were specifically recognised within the education system, and in the labour market. We are aware that alternative outcomes could have been adopted (or scoring methods employed) but we are certain that their substantive interpretation would not have had the same degree of clarity.

	B	SE	Quasi SE	Predictive Margin	Pred. SE
Latent Group 1: 'Low Outcomes' /					
Latent Group 4: 'High Outcomes'					
Gender					
Female	0.00	(0.00)	-	0.00	0.00
Male	0.66***	(0.06)	-	0.10	0.01
Household Type					
Lives with both parents	0.00	(0.00)	0.04	0.00	0.00
Lives with mother only	0.28***	(0.09)	0.08	0.04	0.01
Lives with father only	0.37	(0.32)	0.31	0.06	0.05
Parental Socioeconomic Position (NS-SEC)					
1.1 Large employers and higher managerial	0.60***	(0.17)	0.11	0.09	0.03
1.2 Higher professionals	0.00	(0.00)	0.13	0.00	0.00
2 Lower managerial and professional	0.96***	(0.14)	0.06	0.15	0.02
3 Intermediate	1.31***	(0.15)	0.07	0.21	0.02
4 Small employers and own account	1.44***	(0.17)	0.10	0.24	0.03
5 Lower supervisory and technical	1.83***	(0.17)	0.10	0.31	0.03
6 Semi-routine	2.01***	(0.17)	0.10	0.34	0.03
7 Routine	2.04***	(0.19)	0.13	0.37	0.03
Parental Highest Qualification					
First Degree/Higher Degree	0.00	(0.00)	0.06	0.00	0.00
HNC/HND	0.69***	(0.10)	0.08	0.11	0.02
Highers/CSYS/A-levels	0.75***	(0.09)	0.06	0.11	0.02
O Grade/Standard Grade	1.47***	(0.09)	0.06	0.22	0.02
No Qualifications	2.15***	(0.15)	0.13	0.35	0.02
Unknown	1.15**	(0.42)	0.41	0.27	0.08
Constant	-2.09***	(0.13)	-	-	-
Latent Group 2: 'Middle Non-Science' /					
Latent Group 4: 'High Outcomes'					
Gender					
Female	0.00	(0.00)	-	0.00	0.00
Male	-0.34***	(0.08)	-	-0.09	0.01
Household Type					
Lives with both parents	0.00	(0.00)	0.05	0.00	0.00
Lives with mother only	0.31**	(0.11)	0.09	0.02	0.01
Lives with father only	0.01	(0.44)	0.44	-0.02	0.04
Parental Socioeconomic Position (NS-SEC)					
1.2 Higher professionals	0.00	(0.00)	0.13	0.00	0.00
1.1 Large employers and higher managerial	-0.05	(0.17)	0.13	-0.04	0.02
2 Lower managerial and professional	0.24	(0.13)	0.07	-0.02	0.02
3 Intermediate	0.42**	(0.16)	0.09	-0.02	0.02
4 Small employers and own account	0.33	(0.19)	0.14	-0.04	0.02
5 Lower supervisory and technical	0.40*	(0.19)	0.14	-0.06	0.02
6 Semi-routine	0.54**	(0.18)	0.12	-0.06	0.02
7 Routine	0.47*	(0.22)	0.17	-0.06	0.02
Parental Highest Qualification					
First Degree/Higher Degree	0.00	(0.00)	0.07	0.00	0.00
HNC/HND	0.44***	(0.12)	0.10	0.02	0.01
Highers/CSYS/A-levels	0.36***	(0.11)	0.08	-0.003	0.01
O Grade/Standard Grade	0.85***	(0.11)	0.08	0.003	0.01
No Qualifications	0.92***	(0.19)	0.17	-0.04	0.02
Unknown	-1.25	(1.07)	1.06	-0.12	0.03
Constant	-1.26***	(0.12)	-	-	-

Table 12: Multinomial Logistic Regression Model Results – Latent Educational Group Membership (modal assignment)

Source: Scottish Longitudinal Study

Notes: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	B	SE	Quasi SE	Predictive Margin	Pred. SE
Latent Group 3: 'Middle Science' /					
Latent Group 4: 'High Outcomes'					
Gender					
Female	0.00	(0.00)	-	0.00	0.00
Male	0.88***	(0.07)	-	0.07	0.01
Household Type					
Lives with both parents	0.00	(0.00)	0.05	0.00	0.00
Lives with mother only	0.03	(0.11)	0.10	-0.02	0.01
Lives with father only	0.29	(0.39)	0.38	0.01	0.04
Parental Socioeconomic Position (NS-SEC)					
1.1 Large employers and higher managerial	0.37*	(0.17)	0.12	0.02	0.02
1.2 Higher professionals	0.00	(0.00)	0.13	0.00	0.00
2 Lower managerial and professional	0.34*	(0.14)	0.07	-0.01	0.02
3 Intermediate	0.56***	(0.16)	0.09	-0.01	0.02
4 Small employers and own account	0.59**	(0.18)	0.13	-0.01	0.02
5 Lower supervisory and technical	0.75***	(0.19)	0.13	-0.02	0.02
6 Semi-routine	0.79***	(0.18)	0.12	-0.03	0.02
7 Routine	0.54*	(0.22)	0.17	-0.06	0.02
Parental Highest Qualification					
First Degree/Higher Degree	0.00	(0.00)	0.07	0.00	0.00
HNC/HND	0.21	(0.13)	0.11	-0.02	0.01
Highers/CSYS/A-levels	0.53***	(0.11)	0.08	0.02	0.01
O Grade/Standard Grade	0.89***	(0.11)	0.08	0.005	0.01
No Qualifications	1.06***	(0.18)	0.16	-0.03	0.02
Unknown	0.24	(0.62)	0.62	-0.03	0.06
Constant	-1.97***	(0.13)	-	-	-
Latent Group 4: 'High Outcomes'					
Gender					
Female	0.00	(0.00)	-	0.00	0.00
Male	0.00	(0.00)	-	-0.08	0.01
Household Type					
Lives with both parents	0.00	(0.00)	-	0.00	0.00
Lives with mother only	0.00	(0.00)	-	-0.04	0.01
Lives with father only	0.00	(0.00)	-	-0.04	0.05
Parental Socioeconomic Position (NS-SEC)					
1.1 Large employers and higher managerial	0.00	(0.00)	-	-0.08	0.03
1.2 Higher professionals	0.00	(0.00)	-	0.00	0.00
2 Lower managerial and professional	0.00	(0.00)	-	-0.12	0.02
3 Intermediate	0.00	(0.00)	-	-0.18	0.02
4 Small employers and own account	0.00	(0.00)	-	-0.19	0.03
5 Lower supervisory and technical	0.00	(0.00)	-	-0.23	0.03
6 Semi-routine	0.00	(0.00)	-	-0.25	0.03
7 Routine	0.00	(0.00)	-	-0.25	0.03
Parental Highest Qualification					
First Degree/Higher Degree	0.00	(0.00)	-	0.00	0.00
HNC/HND	0.00	(0.00)	-	-0.11	0.02
Highers/CSYS/A-levels	0.00	(0.00)	-	-0.13	0.02
O Grade/Standard Grade	0.00	(0.00)	-	-0.23	0.02
No Qualifications	0.00	(0.00)	-	-0.29	0.02
Unknown	0.00	(0.00)	-	-0.13	0.08
Constant	0.00	(0.00)	-	-	-
n	8466				
Log likelihood	-9719.59				
McFadden's adjusted R-squared	0.09				

Table 12 (Continued): Multinomial Logistic Regression Model Results – Latent Educational Group Membership (modal assignment)

Source: Scottish Longitudinal Study

Notes: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

9. CONCLUSION

Qualifications gained at school play an important role in determining the transitions that young people make and the educational and employment pathways that they follow. Every summer the British media transmit live broadcasts of groups of young people receiving their grades (Warmington and Murphy 2004, Joint Council for Qualifications 2012, Chalabi 2013, Lim 2013). This reinforces the importance of educational outcomes at the end of compulsory education. We note that on results day media attention tends to be directed towards pupils with outstanding levels of performance. Roberts (2011) employs the term 'missing middle' to describe ordinary young people, and he states that they are often neglected within youth research. Connelly, Murray, and Gayle (2013) suggest that a comprehensive meta-analysis of youth research and its neighbouring disciplines would be required to judge the extent to which a 'middle' group of young people have been ignored. While we note the need for such analysis, the scope of our research programme concerns the identification and analysis of 'middle' or 'moderate' educational outcomes and not the 'missingness' of the 'middle' in the wider youth research agenda.

Improving school qualifications is what psychologists sometimes term as a 'valance', by which they mean the idea is intrinsically attractive. As the educational commentator Ken Robinson suggests it is hard to find a persuasive argument for lower educational standards[15], and there is no reason for us to suspect that outcomes in school qualifications will fall off the political agenda any time soon. The overall message of this work is dispiriting. After half a century of comprehensive education in Scotland, school outcomes remain stratified both by gender and by a pupil's social background.

Despite differences in the Scottish education system these results closely mirror the analyses of school GCSE data from England and Wales reported by Playford and Gayle (2016). Taken together these two sets of analyses indicate that there is a high degree of empirical regularity on both sides of the Scottish border. The analyses uncovered four main latent educational groups. One group had very positive outcomes and pupils in this group were generally more socially advantaged. By contrast another group had very poor outcomes and pupils were generally more socially disadvantaged.

[15] See https://www.thersa.org/globalassets/pdfs/videos/2010/10/rsa-animate---changing-paradigms/rsa-lecture-ken-robinson-transcript.pdf accessed 8th January 2015.

There were two ‘middle’ groups, which both had moderate overall Standard Grade outcomes. Whilst these groups were similar in their agglomerate outcomes, at the subject area-level their outcomes were notably different. Latent group 2 (middle non-science) were more likely to gain a Credit pass in English, but were relatively less likely to gain Credit passes in Mathematics and Sciences. Latent group 3 (middle science) were unlikely to gain Credit passes in English and Mathematics, but were more likely to gain Credit passes in the Sciences.

In the period studied in this paper, as Scottish pupils moved towards the end of compulsory school education they undertook a diet of Standard Grades, which were assessed separately by subject, and a subject-specific Standard Grade was awarded on a seven point scale. There were no specified compulsory sets of Standard Grades and pupils typically studied for around seven or eight Standard Grades from a wider menu of options. There was no obvious single measure of overall Standard Grade outcomes. As we have shown, outcomes in school Standard Grades were also reasonably highly correlated. Therefore the latent variable approach is a practicable solution to loosening this Gordian knot. Iannelli, Smyth, and Klein (2015) argue that taking account of school subjects provides a more complete understanding of the processes that shape social inequality. The latent variable models cope with the messiness of the data on school subjects without resorting to over-simplification.

An important aspect of these empirical analyses is that the degree of detail that was uncovered using the latent variable approach was occluded in analyses of overall Standard Grade outcomes. This approach offers an informative set of typologies that are likely to be impactful because they can be used to better understand patterns of educational outcomes. These typologies are important because they can directly inform current debates on raising standards in Scottish schools, improving pupils’ knowledge, and developing their skills. In particular the evidence that there are hidden groups of ‘ordinary’ young people with different patterns of educational outcomes, and that these pupils may require assistance and encouragement in different areas of the school curriculum is important. This finding appeals to ‘Getting it Right for Every Child’ (GIRFEC), which is the national approach to improving the wellbeing of children and young people in Scotland, as well as the aims of the Curriculum for Excellence reforms

(Kidner 2013), the strategy for developing Scotland's young workforce[16], and the Westminster Government's strengthened approach to tracking the life chances of Britain's most disadvantaged children[17].

Standard Grades were the central school qualifications in Scotland for almost three decades. They have now been replaced by the new 'National' Qualifications Framework (SCQF 2015). Scottish pupils will now study these new qualifications in the final year of compulsory schooling, and unlike Standard Grades they are single year courses. The new National Qualifications are also ungrouped and awarded at the individual subject level. Schools have made different decisions regarding the number of Nationals that a pupil will study, but Kidner (2013) states that this is likely to be approximately six courses. The new Nationals will be available at different levels. National 5 is the higher level qualification and is roughly equivalent to a Credit pass at Standard Grade. National 4 is a lower level qualification, roughly equivalent to a General pass at Standard Grade, and involves only continuous assessment and no formal examination (Kidner 2013). National 4 qualifications will be graded as pass or fail, however the National 5 qualifications will be graded from A to D (with A being the highest grade).

Scottish pupils will undertake about six qualifications from a wide diet of options, at two possible levels, which will be graded on two separate schemes. There is no reason to suspect that pupils' outcomes in individual National Qualifications will not be highly correlated. It is plausible therefore that the methodological problems associated with developing overall or agglomerate measures of school Standard Grade outcomes will also pervade the new National Qualifications. Therefore the latent variable modelling approach demonstrated in this paper continues to be applicable as it provides a practicable solution that will be relevant to analysing emerging data on the new Scottish qualifications.

[16] See http://www.gov.scot/resource/0045/00451746.pdf accessed 29/02/16.
[17] See https://www.gov.uk/government/news/government-to-strengthen-child-poverty-measure accessed 29/02/16.

Roberts and MacDonald (2013) argue that the social scientific focus of youth research has often been on those young people more obviously situated at the margins of society, who are at increased risk of becoming excluded or disconnected from it. They further assert that occasionally there has been direct research interest into the lives of more advantaged young people, especially those who engage in extended periods of education. They warn that youth research is in danger of ignoring the experiences of young people who fall somewhere in-between. The results reported in this work clearly indicate that there are two distinctive groups of Scottish pupils with ‘middle’ or ‘moderate’ school Standard Grade outcomes.

APPENDIX 1

Latent Group	**1 'Low Outcomes'**	**2 'Middle Non-Science'**	**3 'Middle Science'**	**4 'High Outcomes'**
(Posterior Probabilities) Modal Assignment to Group (%)	46%	14%	14%	27%
(Posterior Probabilities) Proportional Assignment to Group (%)	43%	16%	14%	26%
(Prior Probabilities)				
English Credit	4%	59%	37%	83%
English Non-Credit	96%	41%	63%	17%
Maths Credit	1%	6%	27%	80%
Maths Non-Credit	99%	94%	73%	20%
Science Credit	2%	26%	54%	90%
Science Non-Credit	98%	74%	46%	10%
Humanities Credit	3%	56%	61%	88%
Humanities Non-Credit	97%	44%	39%	12%
Languages Credit	1%	28%	18%	73%
Languages Non-Credit	99%	72%	82%	27%
Creative Arts Credit	9%	55%	10%	49%
Creative Arts Non-Credit	91%	45%	90%	51%
Other Subjects Cred.	22%	51%	89%	73%
Other Subjects Non-Credit	78%	49%	11%	27%
n (calculated from estimated posterior probability)	4,110	1,225	1,287	2,410

Table 13: Latent Group Model Results (Four Group Model) School Standard Grade Outcomes – Posterior Probabilities and Prior Probabilities (reported as percentages)

Source: Scottish Longitudinal Study, n=9,032.

Note: All pupils gaining a Standard Grade pass at grades 1-7

Latent Group	1 'Low Outcomes'	2 'Middle Non-Science'	3 'Middle Science'	4 'High Non-Science & Poor Mathematics'	5 'High Poor Mathematics'	6 'High Outcomes'
(Posterior Probabilities) % Assigned to Group	40%	19%	14%	3%	6%	18%
(Prior Probabilities)						
English Credit	1%	37%	43%	100%	76%	89%
Maths Credit	1%	3%	38%	48%	51%	87%
Science Credit	1%	12%	74%	0%	83%	100%
Humanities Credit	0%	39%	67%	78%	86%	90%
Languages Credit	1%	11%	28%	66%	72%	76%
Creative Arts Credit	7%	33%	17%	50%	85%	43%
Other Subjects Credit	19%	49%	85%	92%	32%	81%
n (calculated from estimated posterior probability)	3,654	1,689	1,267	305	525	1,592

Table 14: Latent Group Model Results (Six Group Model) School Standard Grade Attainment – Posterior Probabilities and Prior Probabilities (percentages)

Source: Scottish Longitudinal Study, n=9,032.

	B	SE	Quasi SE	Predictive Margin	Pred. SE
Latent Group 1: "Low Outcomes" / Latent Group 4: "High Outcomes"					
Gender					
Female	0.00	(0.00)	-	0.00	0.00
Male	0.62***	(0.05)	-	0.10	0.01
Household Type					
Lives with both parents	0.00	(0.00)	0.03	0.00	0.00
Lives with mother only	0.27***	(0.08)	0.07	0.04	0.01
Lives with father only	0.23	(0.30)	0.30	0.04	0.05
Parental Socioeconomic Position (NS-SEC)					
1.1 Large employers and higher managerial	0.59***	(0.15)	0.10	0.09	0.02
1.2 Higher professionals	0.00	(0.00)	0.12	0.00	0.00
2 Lower managerial and professional	0.97***	(0.13)	0.05	0.15	0.02
3 Intermediate	1.30***	(0.14)	0.07	0.20	0.02
4 Small employers and own account	1.46***	(0.16)	0.10	0.23	0.02
5 Lower supervisory and technical	1.82***	(0.15)	0.10	0.29	0.02
6 Semi-routine	1.99***	(0.15)	0.08	0.32	0.02
7 Routine	2.06***	(0.17)	0.12	0.35	0.03
Parental Highest Qualification					
First Degree/Higher Degree	0.00	(0.00)	0.06	0.00	0.00
HNC/HND	0.71***	(0.10)	0.08	0.11	0.02
Highers/CSYS/A-levels	0.72***	(0.08)	0.06	0.10	0.01
O Grade/Standard Grade	1.42***	(0.08)	0.06	0.21	0.01
No Qualifications	2.06***	(0.13)	0.11	0.33	0.02
Unknown	1.32***	(0.40)	0.39	0.28	0.07
Constant	-2.08***	(0.12)	-	-	-
Latent Group 2: "Non-Science" / Latent Group 4: "High Outcomes"					
Gender					
Female	-0.12*	(0.06)	-	-0.07	0.01
Male	0.00	(0.00)	-	0.00	0.00
Household Type					
Lives with both parents	0.00	(0.00)	0.03	0.00	0.00
Lives with mother only	0.26**	(0.08)	0.08	0.02	0.01
Lives with father only	0.00	(0.31)	0.31	-0.02	0.03
Parental Socioeconomic Position (NS-SEC)					
1.1 Large employers and higher managerial	0.04	(0.13)	0.10	-0.03	0.02
1.2 Higher professionals	0.00	(0.00)	0.10	0.00	0.00
2 Lower managerial and professional	0.29**	(0.10)	0.05	-0.02	0.02
3 Intermediate	0.48***	(0.12)	0.07	-0.02	0.02
4 Small employers and own account	0.46**	(0.14)	0.10	-0.03	0.02
5 Lower supervisory and technical	0.64***	(0.14)	0.10	-0.04	0.02
6 Semi-routine	0.68***	(0.14)	0.09	-0.05	0.02
7 Routine	0.63***	(0.17)	0.13	-0.06	0.02
Parental Highest Qualification					
First Degree/Higher Degree	0.00	(0.00)	0.06	0.00	0.00
HNC/HND	0.37***	(0.10)	0.08	0.01	0.01
Highers/CSYS/A-levels	0.37***	(0.08)	0.06	<0.01	0.01
O Grade/Standard Grade	0.85***	(0.08)	0.06	0.01	0.01
No Qualifications	1.01***	(0.14)	0.12	-0.03	0.01
Unknown	-0.07	(0.49)	0.48	-0.08	0.03
Constant	-1.26***	(0.10)	-	-	-

Table 15: Multinomial Logistic Regression Model Results – Latent Educational Group Membership (proportional assignment)

Source: Scottish Longitudinal Study

Notes: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Latent Group 3: "Science" /					
Latent Group 4: "High Outcomes"					
Gender					
Female	0.00	(0.00)	-	0.00	0.00
Male	0.70***	(0.06)	-	0.05	0.01
Household Type					
Lives with both parents	0.00	(0.00)	0.04	0.00	0.00
Lives with mother only	0.05	(0.08)	0.08	-0.02	0.01
Lives with father only	0.08	(0.32)	0.32	<-0.01	0.03
Parental Socioeconomic Position (NS-SEC)					
1.1 Large employers and higher managerial	0.33*	(0.13)	0.10	0.02	0.02
1.2 Higher professionals	0.00	(0.00)	0.10	0.00	0.00
2 Lower managerial and professional	0.36***	(0.11)	0.05	<-0.01	0.01
3 Intermediate	0.57***	(0.12)	0.07	<-0.01	0.01
4 Small employers and own account	0.66***	(0.15)	0.11	<-0.01	0.02
5 Lower supervisory and technical	0.78***	(0.14)	0.10	-0.02	0.02
6 Semi-routine	0.82***	(0.14)	0.10	-0.02	0.02
7 Routine	0.68***	(0.17)	0.13	-0.04	0.02
Parental Highest Qualification					
First Degree/Higher Degree	0.00	(0.00)	0.06	0.00	0.00
HNC/HND	0.27**	(0.10)	0.08	-0.01	0.01
Highers/CSYS/A-levels	0.44***	(0.08)	0.06	0.01	0.01
O Grade/Standard Grade	0.78***	(0.08)	0.06	-0.01	0.01
No Qualifications	0.94***	(0.14)	0.13	-0.04	0.01
Unknown	0.28	(0.52)	0.52	-0.04	0.04
Constant	-1.82***	(0.10)	-	-	-
Latent Group 4: "High Outcomes"					
Gender					
Female	0.00	(0.00)	-	0.00	0.00
Male	0.00	(0.00)	-	-0.08	0.01
Household Type					
Lives with both parents	0.00	(0.00)	-	0.00	0.00
Lives with mother only	0.00	(0.00)	-	-0.04	0.01
Lives with father only	0.00	(0.00)	-	-0.02	0.05
Parental Socioeconomic Position (NS-SEC)					
1.1 Large employers and higher managerial	0.00	(0.00)	-	-0.08	0.02
1.2 Higher professionals	0.00	(0.00)	-	0.00	0.00
2 Lower managerial and professional	0.00	(0.00)	-	-0.13	0.019
3 Intermediate	0.00	(0.00)	-	-0.18	0.02
4 Small employers and own account	0.00	(0.00)	-	-0.20	0.02
5 Lower supervisory and technical	0.00	(0.00)	-	-0.24	0.02
6 Semi-routine	0.00	(0.00)	-	-0.25	0.02
7 Routine	0.00	(0.00)	-	-0.26	0.02
Parental Highest Qualification					
First Degree/Higher Degree	0.00	(0.00)	-	0.00	0.00
HNC/HND	0.00	(0.00)	-	-0.11	0.02
Highers/CSYS/A-levels	0.00	(0.00)	-	-0.12	0.01
O Grade/Standard Grade	0.00	(0.00)	-	-0.21	0.01
No Qualifications	0.00	(0.00)	-	-0.27	0.02
Unknown	0.00	(0.00)	-	-0.16	0.07
Constant	0.00	(0.00)	-	-	-
n	8466				
Log likelihood	-10060.86				
McFadden's adjusted R-squared	0.08				

Table 15 (Continued): Multinomial Logistic Regression Model Results – Latent Educational Group Membership (proportional assignment)

Source: Scottish Longitudinal Study

Notes: Standard errors in parentheses; * p < 0.05, ** p < 0.01, *** p < 0.001

Recent work has demonstrated the value of undertaking sensitivity analyses with alternative occupation based measures of socioeconomic position (e.g. Gayle, Connelly, and Lambert 2015b, Lambert and Bihagen 2014). In addition to the multinomial logistic regression models that include parent's National Statistics Socio-Economic Classification (NS-SEC) we have estimated models that included the Cambridge Social Interaction Scale (CAMSIS male scale) (see Prandy 1999) which are reported in Tables 16 and 17. We note that when parental socioeconomic position is measured using CAMSIS it is negative and significant in all pairs of contrasts in the multinomial logistic regression model. This indicates that pupils with parents in less advantaged occupations have lower log odds of being in latent educational group 4 ('high outcomes').

An identical McFadden's adjusted R-squared value of 0.09 is reported for the model that includes NS-SEC, and the model that includes CAMSIS. Gayle (2015) warns against the naïve interpretation of using this measure as an indication of goodness of model fit, however it does provide a useful indication of the proportion of variance explained by the model. It can be argued that CAMSIS is a more suitable measure of parental socioeconomic position because it is a scale, and therefore will generally be more parsimonious within a statistical modelling framework. In situations where one model is to be preferred over another model on the grounds of parsimony we would advocate the calculation of suitable statistics, for example BIC. In the present analyses we have chosen to place more emphasis on the results of the models that include NS-SEC, because this is the official measure currently used by the UK and Scottish Governments and other educational agencies. Results using NS-SEC are therefore more readily comparable with official statistics and much existing educational research.

	B	SE	Quasi SE	Predictive Margin	Pred. SE
Latent Group 1: "Low Outcomes" / Latent Group 4: "High Outcomes"					
Gender					
Female	0.00	(0.00)	-	0.00	0.00
Male	0.64***	(0.06)	-	0.10	0.01
Household Type					
Lives with both parents	0.00	(0.00)	0.04	0.00	0.00
Lives with mother only	0.38***	(0.08)	0.07	0.06	0.01
Lives with father only	0.29	(0.30)	0.30	0.05	0.05
Parental CAMSIS (Male Scale)	-0.04***	(0.00)	-	-0.01	<0.01
Parental Highest Qualification					
First Degree/Higher Degree	0.00	(0.00)	0.06	0.00	0.00
HNC/HND	0.85***	(0.10)	0.08	0.14	0.02
Highers/CSYS/A-levels	0.99***	(0.08)	0.06	0.15	0.02
O Grade/Standard Grade	1.77***	(0.08)	0.06	0.28	0.01
No Qualifications	2.45***	(0.14)	0.12	0.42	0.02
Unknown	1.36***	(0.39)	0.39	0.33	0.08
Constant	1.37***	(0.20)	-	-	-
Latent Group 2: "Non-Science" / Latent Group 4: "High Outcomes"					
Gender					
Female	0.00	(0.00)	-	0.00	0.00
Male	-0.34***	(0.07)	-	-0.09	0.01
Household Type					
Lives with both parents	0.00	(0.00)	0.05	0.00	0.00
Lives with mother only	0.35***	(0.10)	0.09	0.02	0.01
Lives with father only	0.07	(0.40)	0.40	-0.01	0.04
Parental CAMSIS (Male Scale)	-0.01***	(0.00)	-	<0.01	<0.01
Parental Highest Qualification					
First Degree/Higher Degree	0.00	(0.00)	0.07	0.00	0.00
HNC/HND	0.51***	(0.12)	0.10	0.02	0.01
Highers/CSYS/A-levels	0.42***	(0.10)	0.08	-0.01	0.01
O Grade/Standard Grade	0.92***	(0.10)	0.07	-0.01	0.01
No Qualifications	0.93***	(0.18)	0.16	-0.05	0.01
Unknown	-1.40	(1.06)	1.06	-0.13	0.02
Constant	-0.10	(0.24)	-	-	-

Table 16: Multinomial Logistic Regression Model Results – Latent Educational Group Membership (modal assignment) – CAMSIS Parental Occupational Position

Source: Scottish Longitudinal Study

Notes: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	B	SE	Quasi SE	Predictive Margin	Pred. SE
Latent Group 3: "Science" / Latent Group 4: "High Outcomes"					
Gender					
Female	0.00	(0.00)	-	0.00	0.00
Male	0.89***	(0.07)	-	0.08	0.01
Household Type					
Lives with both parents	0.00	(0.00)	0.05	0.00	0.00
Lives with mother only	0.05	(0.10)	0.09	-0.02	0.01
Lives with father only	0.11	(0.38)	0.37	-0.01	0.04
Parental CAMSIS (Male Scale)	-0.02***	(0.00)	-	<0.01	<0.01
Parental Highest Qualification					
First Degree/Higher Degree	0.00	(0.00)	0.07	0.00	0.00
HNC/HND	0.28*	(0.12)	0.11	-0.02	0.01
Highers/CSYS/A-levels	0.60***	(0.10)	0.08	0.01	0.01
O Grade/Standard Grade	0.98***	(0.10)	0.07	-0.00	0.01
No Qualifications	1.08***	(0.17)	0.16	-0.05	0.01
Unknown	0.14	(0.61)	0.61	-0.05	0.05
Constant	-0.43	(0.24)		-	-
Latent Group 4: "High Outcomes"					
Gender					
Female	0.00	(0.00)	-	0.00	0.00
Male	0.00	(0.00)	-	-0.08	0.01
Household Type					
Lives with both parents	0.00	(0.00)	-	0.00	0.00
Lives with mother only	0.00	(0.00)	-	-0.05	0.01
Lives with father only	0.00	(0.00)	-	-0.03	0.05
Parental CAMSIS (Male Scale)	0.00	(0.00)	-	<0.01	<0.01
Parental Highest Qualification					
First Degree/Higher Degree	0.00	(0.00)	-	0.00	0.00
HNC/HND	0.00	(0.00)	-	-0.14	0.02
Highers/CSYS/A-levels	0.00	(0.00)	-	-0.16	0.02
O Grade/Standard Grade	0.00	(0.00)	-	-0.27	0.01
No Qualifications	0.00	(0.00)	-	-0.32	0.02
Unknown	0.00	(0.00)	-	-0.16	0.07
Constant	0.00	(0.00)	-	-	-
n	8691				
Log likelihood	-10002.65				
McFadden's adjusted R-squared	0.09				

Table 16 (Continued): Multinomial Logistic Regression Model Results – Latent Educational Group Membership (modal assignment) – CAMSIS Parental Occupational Position

Source: Scottish Longitudinal Study

Notes: Standard errors in parentheses; * p < 0.05, ** p < 0.01, *** p < 0.001

	B	SE	Quasi SE	Predictive Margin	Pred. SE
Latent Group 1: "Low Outcomes" / Latent Group 4: "High Outcomes"					
Gender					
Female	0.00	(0.00)	-	0.00	0.00
Male	0.60***	(0.05)	-	0.09	0.01
Household Type					
Lives with both parents	0.00	(0.00)	0.03	0.00	0.00
Lives with mother only	0.36***	(0.07)	0.06	0.06	0.01
Lives with father only	0.21	(0.30)	0.30	0.04	0.04
Parental CAMSIS (Male Scale)	-0.04***	(0.00)	-	-0.01	0.00
Parental Highest Qualification					
First Degree/Higher Degree	0.00	(0.00)	0.05	0.00	0.00
HNC/HND	0.86***	(0.09)	0.08	0.14	0.02
Highers/CSYS/A-levels	0.96***	(0.08)	0.06	0.15	0.01
O Grade/Standard Grade	1.73***	(0.08)	0.05	0.26	0.01
No Qualifications	2.38***	(0.12)	0.11	0.40	0.02
Unknown	1.55***	(0.37)	0.37	0.33	0.07
Constant	1.31***	(0.18)	-	-	-
Latent Group 2: "Non-Science" / Latent Group 4: "High Outcomes"					
Gender					
Female	0.00	(0.00)	-	0.00	0.00
Male	-0.12*	(0.06)	-	-0.07	0.01
Household Type					
Lives with both parents	0.00	(0.00)	0.03	0.00	0.00
Lives with mother only	0.27***	(0.08)	0.07	0.01	0.01
Lives with father only	0.06	(0.30)	0.30	-0.01	0.03
Parental CAMSIS (Male Scale)	-0.02***	(0.00)	-	<0.01	<0.01
Parental Highest Qualification					
First Degree/Higher Degree	0.00	(0.00)	0.0492	0.00	0.00
HNC/HND	0.44***	(0.09)	0.0790	0.01	0.01
Highers/CSYS/A-levels	0.46***	(0.08)	0.0616	<-0.01	0.01
O Grade/Standard Grade	0.95***	(0.08)	0.0573	<0.01	0.01
No Qualifications	1.07***	(0.13)	0.1189	-0.04	0.01
Unknown	-0.11	(0.47)	0.4623	-0.09	0.03
Constant	0.14	(0.19)	-	-	-

Table 17: Multinomial Logistic Regression Model Results – Latent Educational Group Membership (proportional assignment) – CAMSIS Parental Occupational Position Measure

Source: Scottish Longitudinal Study

Notes: Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	B	SE	Quasi SE	Predictive Margin	Pred. SE
Latent Group 3: "Science" /					
Latent Group 4: "High Outcomes"					
Gender					
Female	0.00	(0.00)	-	0.00	0.00
Male	0.70***	(0.06)	-	0.05	0.01
Household Type					
Lives with both parents	0.00	(0.00)	0.03	0.00	0.00
Lives with mother only	0.06	(0.08)	0.07	-0.02	0.01
Lives with father only	0.04	(0.31)	0.30	-0.01	0.03
Parental CAMSIS (Male Scale)	-0.02***	(0.00)	-	<0.01	<0.01
Parental Highest Qualification					
First Degree/Higher Degree	0.00	(0.00)	0.05	0.00	0.00
HNC/HND	0.35***	(0.09)	0.0805	-0.01	0.01
Highers/CSYS/A-levels	0.54***	(0.08)	0.0611	0.01	0.01
O Grade/Standard Grade	0.90***	(0.08)	0.0594	-0.01	0.01
No Qualifications	1.03***	(0.13)	0.1226	-0.05	0.01
Unknown	0.28	(0.50)	0.4921	-0.05	0.04
Constant	-0.33	(0.19)	-	-	-
Latent Group 4: "High Outcomes"					
Gender					
Female	0.00	(0.00)	-	0.00	0.00
Male	0.00	(0.00)	-	-0.08	0.01
Household Type					
Lives with both parents	0.00	(0.00)	-	0.00	0.00
Lives with mother only	0.00	(0.00)	-	-0.05	0.01
Lives with father only	0.00	(0.00)	-	-0.02	0.04
Parental CAMSIS (Male Scale)	0.00	(0.00)	-	<0.01	<0.01
Parental Highest Qualification					
First Degree/Higher Degree	0.00	(0.00)	-	0.00	0.00
HNC/HND	0.00	(0.00)	-	-0.13	0.02
Highers/CSYS/A-levels	0.00	(0.00)	-	-0.15	0.01
O Grade/Standard Grade	0.00	(0.00)	-	-0.25	0.01
No Qualifications	0.00	(0.00)	-	-0.31	0.01
Unknown	0.00	(0.00)	-	-0.19	0.06
Constant	0.00	(0.00)	-	-	-
n	8691				
Log likelihood	-10346.62				
McFadden's adjusted R-squared	0.08				

Table 17 (Continued): Multinomial Logistic Regression Model Results – Latent Educational Group Membership (proportional assignment) – CAMSIS Parental Occupational Position Measure

Source: Scottish Longitudinal Study

Notes: Standard errors in parentheses.* p < 0.05, ** p < 0.01, *** p < 0.001

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